University of Bahrain
College of Information Technology
Department of Computer Science
ITCS251/252 Discrete Structure I
2^{nd} Semester 2011/2012
Quiz #1
(Section 1)

9.5

ID: **Name:**

Q1. (10marks) Let $A = \{\varphi, \{1\}, 1\}$ and $B = \{x \in R \mid x^2 - 3x = 0\}$. Find

a) $A \cup B$
b) $A \cap B$
c) $P(A)$
d) $A - B$
e) A partition of A

$A = \{\Phi, \{1\}, 1\}$

$B =$ $x(x-3) = 0$

$x = 0$ or $x = 3$

$B = \{0, 3\}$

a) $A \cup B = \{\Phi, \{1\}, 1, 0, 3\}$ ✓

b) $A \cap B = \Phi$ ✓

c) $P(A) = \{\Phi, \{\Phi, \{1\}, 1\}, \{\{1\}\} \{1\}, \{\Phi, \{1\}\}, \{\Phi, 1\}, \{\{1\}, 1\}\}$

X 1.5

d) $A - B = \{\Phi, \{1\}, 1\} = A$ ✓

e) Let $B = \{\Phi, \{1\}\}$

Let $C = \{1\}$

✓

$B \cup C = \{\Phi, \{1\}, 1\} = A$

$B \cap C = \Phi$

$\therefore$ B, C partition of A

University of Bahrain
College of Information Technology
Department of Computer Science
ITCS 251 Discrete Mathematics
2nd Semester 2011-2012
(Section 1)
Quiz #2

7/8

ID: **Name:**

1. **(4 marks)** Show whether or not the following is a tautology

$$[[(p \to q) \wedge (q \to r)] \to (p \to (r \wedge q))] \equiv (X)$$

p	q	r	$p \to q$	$q \to r$	$r \wedge q$	$(p\to q)\wedge(q \to r)$	$p \to (r \wedge q)$	X
T	T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	F	T
T	F	T	F	T	F	F	F	T
T	F	F	F	T	F	F	F	T
F	T	T	T	T	T	T	T	T
F	T	F	T	F	F	F	T	T
F	F	T	T	T	F	T	T	T
F	F	F	T	T	F	T	T	T

4

$\therefore X$ is a tautology

2. **(1 marks)** Find truth-value of " If 9 is even then 8 is odd "≡ true 1

3. **(3 marks)** Consider the statement
n is prime only if n is odd or n is two
   i) Write the statement in symbolic form
   ii) Write the negation of the statement
   iii) Write the contrapositive statement

let p: n is prime
q: n is odd
r: n is two

i) $(q \vee r) \to \cancel{p}$ 0 $\equiv \sim(q \vee r) \vee p \equiv (\sim q \wedge \sim r) \vee p$

ii) $\sim[(\sim q \wedge \sim r) \vee p] \equiv \sim(\sim q \wedge \sim r) \wedge \sim p$ 1 $\equiv (q \vee r) \wedge \sim p$

- n is odd or it is two, and n is not prime.

iii) $\sim p \to \sim(q \vee r) \equiv \sim p \to (\sim q \wedge \sim r)$ 1

- if n is not odd and it is not two, then n is not prime.

University of Bahrain
College of Information Technology
Department of Computer Science
ITCS251Descrete Mathematics
2^{nd} Semester 2011/2012
(Section 1)
Quiz #3

ID: **Name:**

10

Q1. (4 marks) Determine whether or not the following is valid.

1 $p \rightarrow q$
2 $\sim q \vee r \equiv q \rightarrow r$
$\therefore p \rightarrow r$

from 1 and 2

$p \rightarrow q$
$q \rightarrow r$

$\therefore p \rightarrow r$

4

$\therefore$ Valid

Q2. (6 marks) Determine whether the following argument is valid or not.

1. If you study, then you pass.
2. If you do not study, then I will feel bad.
3. I will not feel bad

$\therefore$ you pass

Let: s: you study
p: you pass
b: feel bad

1 $s \rightarrow p$
2 $\sim s \rightarrow b$
3 $\sim b$

$\therefore p$

6

from 2 and 3

$\sim s \rightarrow b$
$\sim b$

4 $\therefore s$

$\Rightarrow$

from 1 and 4

$s \rightarrow p$
s

$\therefore p$

$\therefore$ Valid

University of Bahrain
College of Information Technology
Department of Computer Science
ITCS 251 Discrete Mathematics
2nd Semester 2011-2012

9

Quiz #4

ID: **Name:**

Q1. (6 marks)
Let D(x): x is a doctor
T(x): x is trained
Convert the following in symbolic using above predicates and quantifiers.

a) All doctors are trained
b) Some doctors are trained
c) No doctor is trained
d) Not all doctors are trained

$\forall_x \; D(x) \rightarrow T(x)$

a) $\forall_x \; D(x) \longrightarrow T(x)$

b) $\exists x \; D(x) \wedge T(x)$

5

d) $\sim(\forall_x \; D(x) \longrightarrow T(x)) \equiv \exists x \sim(\sim D(x) \vee T(x)) \equiv \exists x \; D(x) \wedge \sim T(x)$

c) $\forall x \sim(\cancel{D(x) \rightarrow} T(x)) \equiv \sim(\exists_x \; (D(x) \rightarrow T(x)))$

$\forall_x \; D(x) \rightarrow \sim T(x)$

Q2. (4 marks) Find the truth value for each of the following.

a) $\exists x \in Z, \; x^2 = 4$
b) $\forall x \in Z, \; x^2 = 2$

a) for $x = 2 \in Z \Rightarrow 2^2 = 4 \Rightarrow 4 = 4$ is true
$\therefore \exists x \in Z, \; x^2 = 4$ is true.

b) for $x = 3 \in Z \Rightarrow 3^2 \neq 4 \Rightarrow 9 \neq 4 \;\therefore$ false

$\therefore \forall x \in Z, \; x^2 = 2$ is false.

4

University of Bahrain
College of Information Technology
Department of Computer Science
ITCS251Descrete Mathematics
2nd Semester 2010/2011
Quiz #5
(Section 1)

10

ID: **Name:**

Q1. (5marks). Prove that for all integers a, b, c, if a divides b then a divides bc.

$\forall a,b,c \in Z \quad b = ak_1 \longrightarrow bc = ak$

to assume: $b = ak_1 \quad , k_1 \in Z$
to conclud: $bc = ak$

let: $b = ak_1 \quad , a, b, k_1 \in Z$
by multiplying by c: $, c \in Z$
$bc = ak_1 c$
$bc = ak \quad , k = k_1 c \in Z$

5

$\Rightarrow$ Hence proved.

Q2. (5 marks) Determine whether the following statement is true. If true, then prove it else give counter example.

a) For all integers n, if n^2+1 is odd then n is odd.

b) For all integers n, $\dfrac{n}{n-1}$ is not integer.

a) the statement is false:
counter example:

for $n^2+1 = 17$ (odd)
$n^2 = 16$
$n = \mp 4$ (even)

2.5

b) the statement is false
counter example:

2.5

for $n = 0$

$\frac{n}{n-1} \Rightarrow \frac{0}{0-1} = \frac{0}{-1} = 0 \in Z$

Quiz # 6

Q: A sequence $a_1, a_2, a_3, \ldots$ is defind on:

$a_1 = 3$

$a_k = 7a_{k-1} \quad , k \geq 2$

Show that:

$a_n = 3.7^{n-1} \quad , n \geq 1$

given: $a_1 = 3$

$a_k = 7a_{k-1} \quad , k \geq 2$

To prove: $a_n = 3.7^{n-1} \quad , n \geq 1$

let $p(n)$: $a_n = 3.7^{n-1} \quad , n \geq 1$

Basis: To show $p(1)$:

for $n=1 \Rightarrow a_1 = 3.7^{1-1} = 3.1 = 3$ (True from given)

$\therefore p(1)$

Assumption: let:

$p(k)$: $a_k = 3.7^{k-1} \quad , k \geq 1$

Induction: To show:

$p(k+1)$: $a_{k+1} = 3.7^{k} \quad , k \geq 1$

from given: $a_k = 7a_{k-1}$

for $k = k+1 \Rightarrow a_{k+1} = 7a_k$

$= 7 . 3 . 7^{k-1}$ (from assumption) $, k \geq 1$

$= 3.7^{k} \quad , k \geq 1$

$\therefore p(k+1)$

Hence proved

10

SINAR LINE

Quiz #7

10

Q. Let $f: Z \to Z$ defined by: $f(x) = x^2$

Is f

a) one-To-one , b) on-To

a) f is one-To-one $\longleftrightarrow \forall x_1, x_2 \in Z \quad f(x_1) = f(x_2) \longrightarrow x_1 = x_2$

to assume: $f(x_1) = f(x_2)$

to conclude: $x_1 = x_2$

Let $x_1, x_2 \in Z$ and $f(x_1) = f(x_2)$

$$x_1^2 = x_2^2$$

$$x_1 = \pm x_2$$

Let $x_1 = 2 \in Z$, $x_2 = -2 \in Z$

$L.H.S = 2^2 = 4$

$R.H.S = (-2)^2 = 4$

$\therefore f(x_1) = f(x_2)$ but $x_1 \neq x_2$

$\therefore$ not one-To-one.

5

b) f is on-To $\longleftrightarrow \forall y \in Z^+ \; \exists x \in Z \quad y = f(x)$

$$y = x^2$$

$$x = \pm\sqrt{y}$$

for $y = 2 \in Z^+$

$x \notin Z$

$\therefore$ not on-To

5

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University of Bahrain
College of Information Technology
Department of Computer Science
ITCS251Descrete Mathematics
2nd Semester 2011/2012
Quiz #8

10

ID: **Name:**

Q1. (6marks) Prove that for all positive integers a, b, c if a divides b and b divides c then a divides c.

$\forall a,b,c \in Z^+ \quad b = ak_1 \wedge c = bk_2 \longrightarrow c = ak$

To assume: $b = ak_1$, $c = bk_2$, $a,b,c \in Z^+$, $k_1, k_2 \in Z$

To conclude: $c = ak$

$c = bk_2 \Rightarrow c = (ak_1)k_2$ (from assumption) 6

$c = a(k_1 k_2)$

$c = ak \quad , k \in Z, \ k = k_1 k_2$

Hence proved.

Q2. (4marks) Is the following true? If yes, then prove it. If false, give a counter example.

For all integers n, $\dfrac{n^2}{n^2+1}$ is not an integer.

false.

4

counter example:

For $n = 0 \in Z \Rightarrow \dfrac{n^2}{n^2+1} = \dfrac{0}{0+1} = 0 \in Z$